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Research Article

The Use of Computer-Based Interactive Games in Teaching Science Concepts for Struggling Learners: Basis for a Compilation of Recommended Games in Teaching

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ABSTRACT

Games have been used and proven effective in motivating students. Playing interactive games can enhance learning (Lieberman, 2006). This study aimed to evaluate the effectiveness of computer-based interactive games in teaching students who are struggling to learning concepts in Physical Science. It also determined to identify the students' attitudes towards the use of computer-based interactive games. This study utilized pre-test and post-test designs. Respondents for this study were Grade 11 struggling learners and were determined based on the learners' general average grade during the first semester. The two experimental treatment groups were randomly assigned. One group was taught using computer-based interactive games as an intervention, while the other did not have any teaching intervention. Both groups had regular class instruction in Physical Science and were taught the same content and the same amount of time. The findings reveal that upon exposure to computer-based interactive games, struggling students' performance in science concepts as described by their pre-test and post-test scores were statistically different with the performance of the struggling students using the lecture-discussion approach. The result implies that students enhanced by the computer-based interactive games approach performed at par with those exposed to traditional learning. Hence, the use of computer-based interactive games in teaching Physical Science concepts is recommended, in addition to regular class instruction. It is suggested that science teachers, especially senior high school teachers who teach Physical Science, should integrate and use computer-based interactive games since it promotes a better understanding of the lesson.

Keywords: *struggling learners, computer-based interactive games, experimental group, control group, academic performance*

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Background

"I hear, and I forget. I see, and I remember. I do, and I understand." This remarkable Chinese proverb coined by Confucius makes teachers think of innovating their teaching strategies and find ways to ensure meaningful teaching and learning experience among students. It also implies the importance of learning by doing, wherein the students play an active part in the learning process.

Innovating teaching strategies is a necessity because there is no single teaching strategy that works best. According to the US Department of Education, innovation in education pertains to the use of new technologies in the classroom. Zuljan and Vogrinc (2010) believed that innovation and didactic learning strategies are among the basic demands of teacher training in all levels of education. Furthermore, they stressed that teachers might help foster and promote each child's creative potential by incorporating creativity into their teaching practices. Calderon (2014) agreed that every child is expected to succeed, and teachers will be held accountable for making it happen. She further added that students do not fail; teachers do.

Innovations in education should not stop because change is inevitable. Students change in their behavior, attitude, and interest in learning. Hence, innovation of teaching strategies is vital in today's world to meet these changes.

However, some schools and teachers continue to adopt approaches that result in little or no advancement for students (Adams, 2017). Though some teachers are still using the traditional method in teaching, the time will come that teachers will eventually change and appreciate the usefulness of technology in the delivery of education.

According to UNICEF, innovation implies coming up with a fresh, straightforward solution to solve a real problem in order to promote fair learning.

For the past few years, statistics have shown that the performance of the high school students in science has not met the Mean Percentage Score (MPS) of 75% as described by the results of the 2012 National Achievement Test (Philippine Basic Education, 2014). One of the reasons why students got low scores, and poor ratings in NAT is the lack of modern technologies in teaching and failure to integrate Information Communication Technology (ICT) (Rayos, 2015). Students' success on the National Achievement Test is considered to be directly correlated with technology, media, and study habits (Anastacia, 2011). However, despite the support given by the government in providing ICT resources in our schools today, the problem remains unsolved.

Based on the observations and experience of the researcher in teaching for three (3) years, he found out that negative attitudes toward the subject, low motivation and interest, and ineffective teaching strategies contributed to the low performance of the high school students. Games have been used and proven effective in motivating students. Lieberman (2006) asserted that playing interactive games can enhance learning.

On the other hand, the researcher has found out that there are few interactive science games available online. Hence, there is a need to develop science computer-based interactive games.

To date, study on how to help struggling students learn science concepts is still underexplored, and this becomes the impetus for this study.

This study aims to examine the effectiveness of the developed computer-based interactive games in enhancing the performance of struggling students and identify their attitudes towards these games.

Statement of the Problem

This study examined the effect of employing computer-based interactive games on the performance of struggling learners in Science. Specifically, this study sought to answer the following research questions: (1) What is the attitude of the struggling learners towards computer-based interactive games? (2) What is the performance of the struggling learners in Science before and after applying computer-based interactive games? (3) Is there a significant difference in the respondents' performance in Physical Science before and after computer-based interactive games were employed? (4) Is there a significant difference in the post-test performance in Physical Science of the

struggling learners exposed to computer-based interactive games and lecture-discussion? (5) What computer-based interactive game(s) is/are the most effective in enhancing struggling learners' performance in Science?

Methods

This study employed the pre-test-post-test experimental design to identify the effectiveness of interactive games as a teaching strategy in enhancing the performance of struggling learners in science and the student's attitude towards interactive games. Analysis of the performance of the struggling learners in science concepts is based on the result of their pre-test and post-test scores when lecture-discussion and computer-based interactive games are employed.

Two heterogeneous groups were identified. One group was used as an experimental setup, and the other group was set as the controlled setup. Each group was given a pre-test to determine their prior knowledge of Physical Science concepts before they were taught. One group was set for the traditional lecture discussion, and the other group was for computer-based interactive games. After employing both teaching approaches, the researcher had administered a post-test to the two groups.

The instruments for this study were the three sets of 20-item multiple-choice tests covering the topics included in the curriculum guide in Physical Science. These written tests were constructed by the researcher guided by the Table of Specification (TOS).

To assess the content validity of the written tests, the researcher's adviser and experienced science experts checked these tests to ascertain clarity of expressions, appropriateness to the student's level, and readability. They were consulted to review the test items and provide feedback on its validity.

To assess the reliability of the test, this was pilot tested on thirty (30) students. The reliability index of the written test using.

Result and Discussion

The table presented shows the attitude of the struggling learners towards using computer-based interactive games in the classroom. Based on the analysis, it was found out that nine out of nineteen statements gained positive feedback from those students in the experimental group.

On average, the data also reveals that the respondents have a positive attitude towards

Kuder-Richardson Formula -21 for pre-test and post-test was found out to be 0.75 and 0.836, respectively.

To measure the attitude of the students towards the use of computer-based interactive games, a 4- point Likert scale composed of 19 items was used. Using computer-based interactive games in the classroom with an overall mean rating of 3.26.

This implies that using computer-based interactive games may be used as one of the strategies in teaching science concepts among struggling learners since it was found out that the respondents have a positive attitude towards this teaching strategy.

Table 1. Struggling Learners' Attitude towards Computer-Based Interactive Games
n = 28

Statements	Mean Rating	Qualitative Description
I enjoy doing activities with the use of interactive games	3.89	Positive
I enjoy playing games in class and at the same time I also learn	3.76	Positive
I think interactive games are important and useful for better leaning	3.54	Positive
I learn many things in science because of interactive games	3.39	Positive

Statements	Mean Rating	Qualitative Description
Using interactive games improved my academic performance in science	3.36	Positive
I like playing interactive games in class	3.32	Positive
Interactive games are interesting to do	3.32	Positive
Interactive games are better than traditional games	3.25	Positive
Interactive games motivate me to explore science more	3.25	Positive
Interactive games make me attentive and participative in class	3.21	Neutral
Interactive games develop my thinking and creativity skills	3.18	Neutral
Using interactive games seems interesting to me	3.18	Neutral
I learn science concepts easily because of interactive games	3.14	Neutral
Using interactive games enabled me to comply with requirements given by my teacher, it develop a willingness to do comply with the task	3.14	Neutral
Interactive games motivate me to learn	3.07	Neutral
Interactive games are easy to manipulate thus it makes the lesson easy for me to understand.	3.04	Neutral
Interactive games motivate me to attend a class every day	2.96	Neutral
Interactive games help me to enhance my social skills	2.96	Neutral
Interactive games help me easily understand some parts of the lesson	2.93	Neutral
OVER-ALL MEAN RATING	3.26	Positive

Table 2. Struggling Learners' Performance in Science (Over-All Mean Rating)
n= 28

	PRE-TEST		POST TEST	
	Mean Rating	Qualitative Description	Mean Rating	Qualitative Description
TOPIC 1	7.32	Poor	15.3	Very Satisfactory
TOPIC 2	7.79	Poor	13.1	Satisfactory
TOPIC 3	12.9	Satisfactory	17.4	Very Satisfactory
Over-All	9.34	Fairly Satisfactory	15.25	Very Satisfactory

Table 2 shows the mean performance of the struggling learners in science among the three identified topics: *Topic 1: Ideas on Ancient Greeks on Atoms and Elements, Topic 2: Development of Atomic Models and the Subatomic Particles, and Topic 3: Polarity of Molecules.* As depicted by the table above, it clearly shows how the mean scores of the struggling learners improved after computer based interactive games were employed in teaching science topics.

Further analysis also reveals that before computer-based interactive games were employed, a typical struggling learner had a fairly satisfactory performance with a mean score of 9.34. However, after the experimentation, the performance of this typical struggling learner improved from 9.34 to 15.25 (fair satisfactory to very satisfactory).

Table 3. Differences on the Respondents' Performance in Physics Before and After CBIG was Employed n = 28 (Experimental Group)

		Mean	Standard Deviation	t - value	p – value	Interpretation
TOPIC 1	Before	7.32	2.59	13.69	0.000**	Significant
	After	15.28	1.65			
TOPIC 2	Before	7.78	2.33	7.43	0.000**	Significant
	After	13.07	2.95			
TOPIC 3	Before	12.92	3.59	5.86	0.000**	Significant
	After	17.35	1.74			

Table 3 above shows that there are significant differences in the performance of the struggling learners in science before and after computer-based interactive games were employed among the three identified topics. Using t-test for paired data, it can be gleaned that the differences in the respondents' performance before and after the intervention are statistically significant since the computed p-values are all lesser than the indicated level of significance of 0.05. Moreover, it can also be noted that significant improvements in the respondents' test scores were observed after the experimentation. This implies that the use of computer-based interactive games significantly improved the performance of the struggling learners in learning the concepts in Physical Science.

Table 4. Differences on the Respondents' Performance in Physics After CBIG was Employed Controlled Group VS Experimental Group
$n_1 = 28$; $n_2 = 28$

		Mean	Standard Deviation	t - value	p – value	Interpretation
TOPIC 1	Controlled	10.78	3.14	6.69	0.000**	Significant
	Experimental	15.28	1.65			
TOPIC 2	Controlled	10.74	2.79	3.002	0.004**	Significant
	Experimental	13.67	2.95			
TOPIC 3	Controlled	15.89	2.66	2.424	0.018**	Significant
	Experimental	17.34	1.74			

Legend: ***Significant at 0.05 level of significance*

Table 4 above shows that there are significant differences between the performance of the struggling learners from the experimental group and the controlled group as described by their post-test performance. Using t-test for independent, it can be gleaned that the differences in the performance of the controlled and experimental groups are significant since the computed p-values are all lesser than the indicated level of significance of 0.05.

This finding strongly suggests that students who were exposed to computer-based interactive games performed better in Physical Science than those students who were taught using lecture-discussion.

Table 5. Relationship between the Identified Interactive Games and the Struggling Learners' Performance in Science

Interactive Games	Correlation Coefficient	Qualitative Description	p - value	Interpretation
1. Timeline Quiz	0.651	High Positive Correlation	0.0175**	Significant
2. Alchemy	0.879	Very High Positive Correlation	0.0135**	Significant
3. Who & What	0.127	Negligible Correlation	0.4718	Not Significant
4. Legendary Chemist	0.638	High Positive Correlation	0.0082**	Significant
5. Chem Arcade	0.374	Low Positive Correlation	0.403	Not Significant
6. Chemistry Helper	0.739	High Positive Correlation	0.0138**	Significant

Legend: ***Significant at 0.05 level of significance*

As presented on the table in the preceding page, among the six identified interactive games, it was found out that *Alchemy 2* was the most effective in enhancing the learning experience of the struggling learners. This was followed by *Legendary Chemist, Chemistry Helper, and Timeline Quiz.*

The correlation coefficient and p-values confirm that these computer-based interactive games have a bearing on their performance in science.

Conclusion

1. Struggling students have a positive attitude towards the learning benefits of interactive games.
2. Students taught using computer-based interactive games performed better in Physical Science tests than those without teaching intervention.
3. There is a significant difference in the students' performance in Physical Science before and after being taught using computer-based interactive games.
4. There is a significant difference in the post-test performance of the struggling learners between those exposed to computer-based interactive games and lecture-discussion.
5. Among the six identified interactive games, the following have significant effects on the academic performance of the struggling students in learning science concepts: Alchemy 2, Chemistry Helper, Timeline Quiz, and Legendary Chemist.

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